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September 30, 2015  
File No. 22306

Mr. Kevin J. Carrier, P.E.  
Lake County Division of Transportation  
600 W. Winchester Road  
Libertyville, IL 60048

Re: Geotechnical Investigation  
21<sup>st</sup> Street  
Zion, Illinois

Dear Mr. Carrier:

The following is our report of findings for the geotechnical investigation completed on 21<sup>st</sup> Street between Sunnyside Drive and Kenosha Road in the City of Zion, Illinois.

The investigation was requested to determine subsurface soil conditions in proposed pavement areas. The information is intended to assist in planning, design and construction of the proposed pavement improvements. We understand the north and south sides of 21<sup>st</sup> street will be widened to provide a new turn lanes into the Shepherds Point Subdivision.

#### SCOPE OF THE INVESTIGATION

A total of 8 boring locations were established as shown on the enclosed location sketches. The supporting soils were visually and texturally classified in the field to depths of 5.0 feet. Soil samples were obtained using a split barrel sampler advanced utilizing an automatic SPT hammer.

Soil samples obtained during the field investigation were returned to our laboratory for review and testing. Soil testing included determination of moisture content. Cohesive soils obtained by split barrel sampling were further tested to determine dry unit weight and unconfined compressive strength. The results of all field and laboratory testing are included in summary with this report. The results of all field determinations and laboratory testing are included in summary with this report.

Additionally, 8 hand auger samples were performed in the area of the proposed drainage ditches to determine the depth of surface topsoil.

#### RESULTS OF THE INVESTIGATION

Enclosed are boring logs indicating the soil conditions encountered at each location. Site surface conditions include pavement materials, vegetation, topsoil and fill soil conditions. The topsoil is classified as dark brown to black silt/clay mixtures with traces of roots usually present.

Fill soil conditions were encountered at each boring location. Composition of the fill includes the presence of limestone, sand/gravel, and clay/silt mixtures extending to depths of 0.5 feet to 3.5 feet at these boring locations. The limits of fill placement were not determined within the scope of this investigation. The fill soil conditions are found to overlie the apparent natural topsoil at borings B-1, B-3, and B-4 extending to depths of 3.0 feet to 3.5 feet.

Underlying natural soil conditions include the presence of non-cohesive soils. These include very loose to medium dense silt/clay mixtures in a damp to very damp condition. Cohesive soils were also discovered as indicated. These are classified as stiff to hard clay/silt mixtures with lesser portions of sand and gravel. Cobbles and boulders may be present within the site soils at any elevation, although none were encountered while drilling.

A total of 8 probes were performed in the area of proposed drainage ditches to determine the depth of surface topsoil. The locations are shown on the attached sketches with results listed below.

<u>Location</u>	<u>Depth of Surface Topsoil (in.)</u>
P-1	18.0
P-2	2.0
P-3	8.0
P-4	4.0
P-5	1.0
P-6	0.0
P-7	0.0
P-8	0.0

#### SUBGRADE PREPARATION

Generally, normal subgrade preparation is anticipated for the pavement widening of 21st Street. This would include the complete removal of the existing pavement materials along with unsuitable surface conditions including vegetation, high organic content topsoil, significant debris and other deleterious conditions which may be encountered in accordance with Article 202.03 of the standard specifications. Any unsuitable soils should be removed to a distance of at least 1.0 foot behind the proposed shoulder. Additional over-digging equal to the depth of fill required below the shoulder should be considered. An increased width of soil removal may be necessary when subgrade supported improvements such as sidewalks, drives or paved shoulders are planned. The soils in cut areas should be excavated to establish design subgrade elevations. After removal has been completed the soils should be compacted to a minimum of 95% compaction based on the standard proctor, AASHTO T-99 or ASTM D-698, within 1.0 foot of the surface. The exposed subgrade soils should then be proof-rolled.

If proof-rolling reveals unstable soil conditions due to high moisture contents these soils should be aerated or removed. Discing and aeration of the soil can be effective to depths of up to 1.0 foot depending upon the equipment used. If the high moisture content condition extends to depths greater than the effective depth of discing, removal of the unstable soils will be necessary.

We would anticipate the need for undercutting in the areas of borings B-1, B-3 and B-4 due to the presence of deeper fill soils and buried topsoil. The actual need for removal and replacement with a woven geotextile fabric and Porous Granular Embankment, Special should be determined in the field at the time of construction by the Geotechnical Engineer or Resident Engineer. All potentially unstable soils should be tested with a cone penetrometer and treated in accordance with Article 301.03 of the standard specifications and the undercut guidelines in the IDOT Subgrade Stability Manual.

Areas where fill is required to establish the design subgrade elevation should be prepared as indicated above. Properly prepared areas can then be filled using suitable onsite soils or an approved offsite source. Fill soil should be placed in lifts not to exceed 8.0 inches when uncompacted. Each lift should exceed the minimum compaction requirement prior to placement of the next lift. If high soil moisture content prevents achieving minimum compaction requirements then it will be necessary to disc and aerate the soil prior to final compaction. Compaction requirements also apply to backfill placement around structures and within trench excavations located beneath pavement areas.

The new pavement section should include the 12 inch Aggregate Subgrade in the design. For further reference, IDOT specifications for subgrade preparation are given in Section 301 of the Standard Specifications

### CONCLUSION

The information within this report is intended to provide initial information concerning subsurface soil and water conditions on the site. Variations in subsurface conditions are expected to be present between boring locations due to naturally changing soil and fill conditions.

Our understanding of the proposed improvements is based on limited information available to us at the writing of this report. The findings of the investigation and the recommendations presented are not considered applicable to significant changes in the scope of the improvements or applicable to alternate site uses. We recommend that proposed pavement and grading plans be reviewed by our office to determine if additional considerations are necessary to address anticipated subsurface conditions.

The soils exposed in soil undercut areas should be evaluated for suitability prior to placement of fill, as previously indicated in this report. Soils and aggregates placed as structural fill should be tested as the work progresses to verify that minimum compaction requirements have been met.

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Re: 21<sup>st</sup> Street  
Zion, Illinois

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If you have any questions concerning the findings or recommendations presented in this report, please let me know.

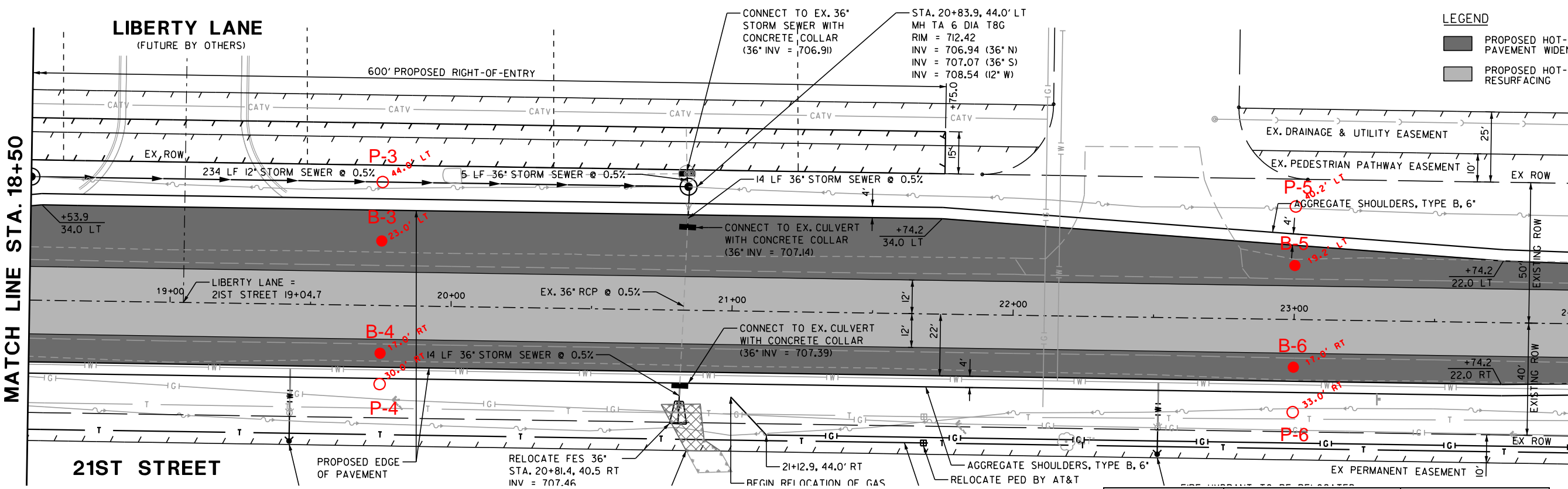
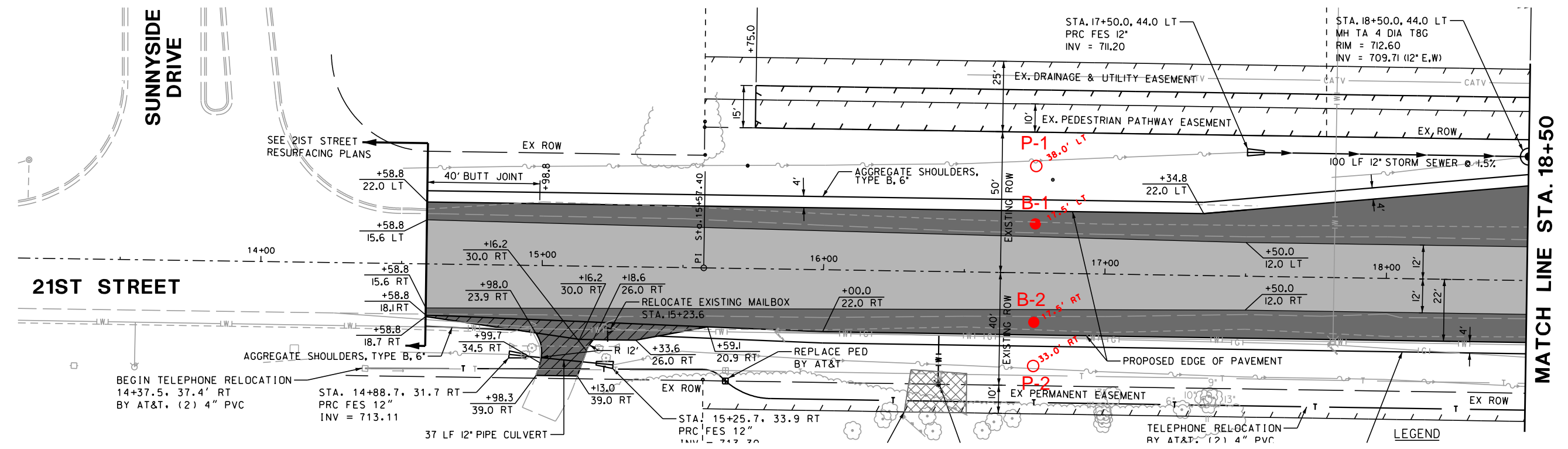
Very truly yours,

SOIL AND MATERIAL CONSULTANTS, INC.

A handwritten signature in purple ink, appearing to read "Thomas P. Johnson".

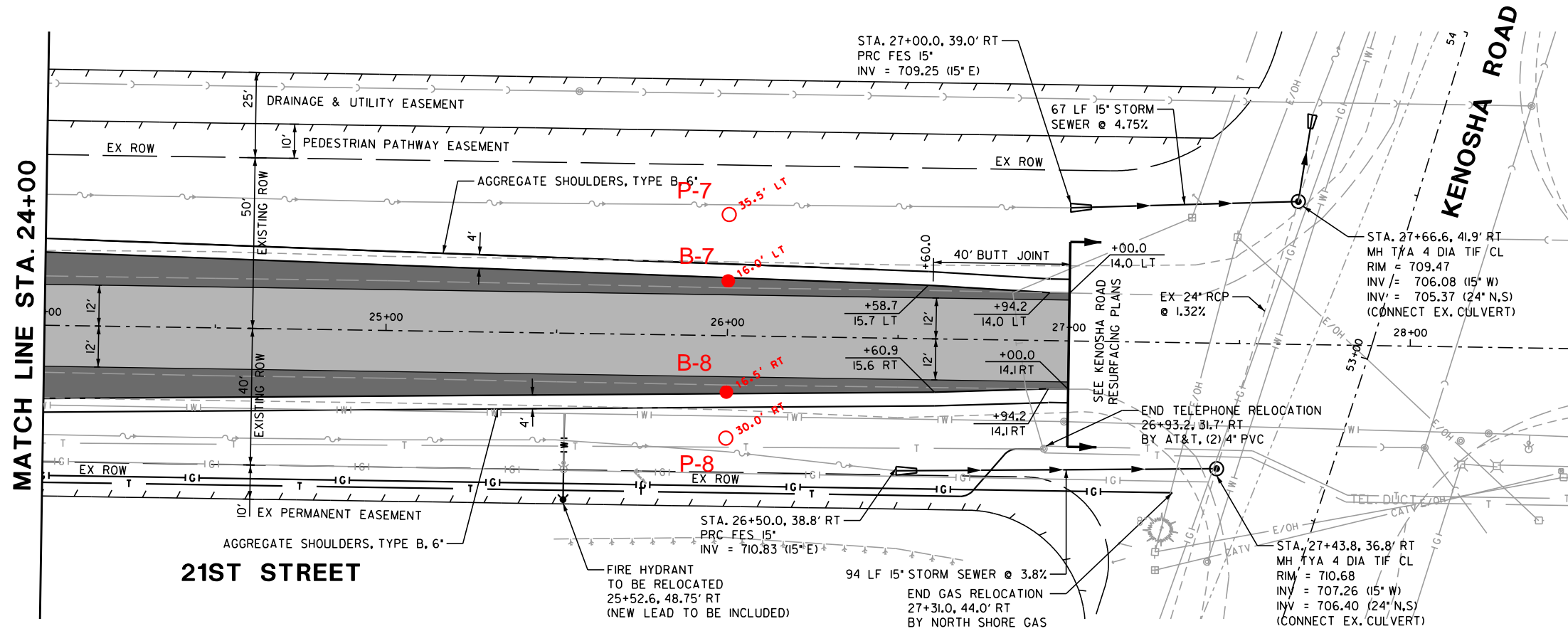
Thomas P. Johnson, P.E.  
President

TPJ:ek  
Enc.



SMC		SOIL AND MATERIAL CONSULTANTS, INC.	LOCATION SKETCH
Client:	LAKE COUNTY DIVISION OF TRANSPORTATION		
Project:	21 <sup>ST</sup> STREET		
Location:	ZION, ILLINOIS		
File No.	22306	Date: 9-10-15	Scale: 1" ≈ 40'





- LEGEND**
- PROPOSED HOT-MIX ASPHALT PAVEMENT WIDENING
  - PROPOSED HOT-MIX ASPHALT RESURFACING

SMC		SOIL AND MATERIAL CONSULTANTS, INC.	LOCATION SKETCH
Client:	LAKE COUNTY DIVISION OF TRANSPORTATION		
Project:	21 <sup>ST</sup> STREET		
Location:	ZION, ILLINOIS		
File No.	22306	Date: 9-10-15	Scale: 1" ≈ 40'



Client: Lake County Division of Transportation

File No. 22306

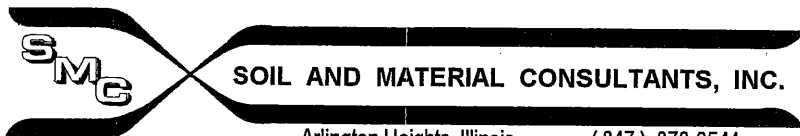
Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 16+75, 17' Lt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<div>○ unconfined compressive strength, tons/sq.ft.</div> <div>● penetrometer reading, tons/sq.ft.</div> <div>1.0 2.0 3.0 4.0</div>			
	CLASSIFICATION					<div>× standard penetration "N", blows/ft.</div> <div>△ moisture content, %</div> <div>10 20 30 40</div>			
	Elevation Existing Surface	×	△	×	○				
	Limestone,damp - 10.0"								
1	Brown-dark brown-black clay & silt,trace sand & gravel,damp,very tough - Fill								
2									
		5	16.9	114.2	2.3	×	△	○	
3	Black silt,some clay,trace sand,damp (topsoil)								
			26.5					△	
4	Brown silt,some clay,trace sand & gravel, damp,very loose								
5	End of Boring	4	25.2			×		△	
6									
7									
8									
9									
10									

Water encountered at dry feet during drilling operations (W.D.).  
Water recorded at dry feet on completion of drilling operations (A.D.).  
Water recorded at feet hours after completion of drilling operations (A.D.).



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# SOIL BORING LOG 2

Logged By: DA

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Client: Lake County Division of Transportation

File No. 22306

Date Drilled: 9/10/15

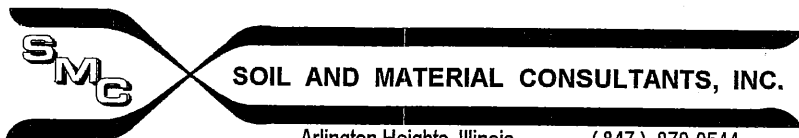
Reference: 21st Street  
Zion, IL

Comments: Station 16+75, 17' Rt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<div>○ unconfined compressive strength, tons/sq.ft.</div> <div>● penetrometer reading, tons/sq.ft.</div> <div>1.0 2.0 3.0 4.0</div>				<div>✕ standard penetration "N", blows/ft.</div> <div>△ moisture content, %</div> <div>10 20 30 40</div>			
	CLASSIFICATION	✕	△	⌘	○								
	Elevation Existing Surface												
	Limestone,damp - 3.0"												
	Brown sand & gravel,damp - 7.0" Fill												
1	Brown-dark brown-black clay & silt,trace sand & gravel,damp,very tough - Fill												
2													
3		8	22.9	102.6	3.3	✕		△	●	○			
4	Brown clay,some silt,trace sand,damp, stiff		22.7	103.7	0.8	○	●	△					
5	Brown silt,some clay,trace fine sand,damp loose												
6	End of Boring	6	19.0			✕		△					
7													
8													
9													
10													

Water encountered at dry feet during drilling operations (W.D.).  
 Water recorded at dry feet on completion of drilling operations (A.D.).  
 Water recorded at feet hours after completion of drilling operations (A.D.).





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# SOIL BORING LOG 3

Logged By: DA

Page: 1 of 1

Client: Lake County Division of Transportation

File No. 22306

Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 19+75, 23' Lt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<div> <input type="radio"/> unconfined compressive strength, tons/sq.ft.  <input checked="" type="radio"/> penetrometer reading, tons/sq.ft.            1.0 2.0 3.0 4.0         </div>			
	CLASSIFICATION					<div> <input checked="" type="radio"/> standard penetration "N", blows/ft.  <input type="radio"/> moisture content, %            10 20 30 40         </div>			
Elevation	Existing Surface	X	Δ	γ	○				
1	Dark brown-brown-black silt, some clay, trace sand & roots, damp (topsoil) - Fill		26.0						
2	Black silt, some clay, trace sand, damp, loose (topsoil)	5	34.3			X		Δ	
3									
4	Brown-gray clay, some silt, trace sand & gravel, damp, hard								
5	End of Boring	13	17.5	112.9	4.7	XΔ			γ○
6									
7									
8									
9									
10									

Water encountered at dry feet during drilling operations (W.D.).  
 Water recorded at dry feet on completion of drilling operations (A.D.).  
 Water recorded at feet hours after completion of drilling operations (A.D.).



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**Date Drilled:** 9/10/15

**Comments:**

## CLASSIFICATION

Elevation	Existing Surface
10.00	Asphalt
9.50	Grass
9.00	Grass
8.50	Grass
8.00	Grass
7.50	Grass
7.00	Grass
6.50	Grass
6.00	Grass
5.50	Grass
5.00	Grass
4.50	Grass
4.00	Grass
3.50	Grass
3.00	Grass
2.50	Grass
2.00	Grass
1.50	Grass
1.00	Grass
0.50	Grass
0.00	Grass
-0.50	Grass
-1.00	Grass
-1.50	Grass
-2.00	Grass
-2.50	Grass
-3.00	Grass
-3.50	Grass
-4.00	Grass
-4.50	Grass
-5.00	Grass
-5.50	Grass
-6.00	Grass
-6.50	Grass
-7.00	Grass
-7.50	Grass
-8.00	Grass
-8.50	Grass
-9.00	Grass
-9.50	Grass
-10.00	Grass

Brown sand & gravel, damp - 9.0" Fill

1- Black-gray-black clay & silt, trace sand  
& gravel, damp, tough - Fill

2	
	Black silt, some clay, trace sand, damp, loose (topsoil)

4- Brown-gray clay, some silt, trace sand,  
damp, stiff

End of Boring

standard  
penetration

moisture  
contentdry unit weight  
lbs./cu.ft.

unconfined compressive strength

○ unconfined compressive strength, tons/sq.ft.

- penetrometer reading, tons/sq.ft.

1.0      2.0      3.0      4.0

✕ standard penetration "N", blows/ft.

$\Delta$  moisture content, %

10      20      30      40

5

20.7

27.6

6

23.6

100.1

0.9

Water encountered at \_\_\_\_\_  
 Water recorded at \_\_\_\_\_  
 Water recorded at \_\_\_\_\_

dry  
dry

feet during drilling operations (W.D.).

feet on completion of drilling operations (A.D.).

feet                      hours after completion of drilling operations (A.D.).

Logged By: DA

Page: 1 of 1

Client: Lake County Division of Transportation

File No. 22306

Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 23+00, 19' Lt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<input type="radio"/> unconfined compressive strength, tons/sq.ft. <input checked="" type="radio"/> penetrometer reading, tons/sq.ft. 1.0 2.0 3.0 4.0			
	CLASSIFICATION					<input checked="" type="radio"/> standard penetration "N", blows/ft. <input type="radio"/> moisture content, % 10 20 30 40			
	Elevation Existing Surface	X	Δ	⌘	○				
	Limestone, damp - 3.0"								
	Brown sand & gravel, damp - Fill								
1	Brown-gray clay, some silt, trace sand & gravel, damp, very tough to hard								
2									
3									
4									
5	End of Boring	7	19.6	106.6	3.5	X	Δ	●	○
6									
7									
8									
9									
10									

Water encountered at  
Water recorded at  
Water recorded at

dry  
dry

feet during drilling operations (W.D.).  
feet on completion of drilling operations (A.D.).  
feet hours after completion of drilling operations (A.D.).



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Arlington Heights, Illinois (847) 870-0544

## SOIL BORING LOG 6

Logged By: DA

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Client: Lake County Division of Transportation

File No. 22306

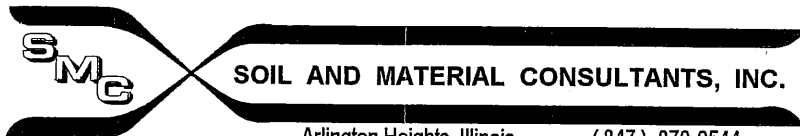
Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 23+00, 19' Rt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<div>○ unconfined compressive strength, tons/sq.ft.</div> <div>● penetrometer reading, tons/sq.ft.</div> <div>1.0 2.0 3.0 4.0</div>				<div>✕ standard penetration "N", blows/ft.</div> <div>△ moisture content, %</div> <div>10 20 30 40</div>			
	CLASSIFICATION	✕	△	✕	○								
	Brown sand & gravel,damp - Fill												
1	Brown-gray clay,some silt,trace sand & gravel,damp,hard												
2													
3		10	17.2	109.6	5.2	✕	△					○	
4	Brown silt,some clay,trace fine sand, damp-very damp,loose												
5	Brown clay,some silt,trace sand,damp, very tough	10	22.3			✕		△					
	End of Boring		19.0						●				
6													
7													
8													
9													
10													

Water encountered at dry feet during drilling operations (W.D.).  
 Water recorded at dry feet on completion of drilling operations (A.D.).  
 Water recorded at feet hours after completion of drilling operations (A.D.).



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# SOIL BORING LOG

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Logged By: DA

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Client: Lake County Division of Transportation

File No. 22306

Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 26+00, 16' Lt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration	moisture content	dry unit weight lbs./cu.ft.	unconfined compressive strength	<div>○ unconfined compressive strength, tons/sq.ft.</div> <div>● penetrometer reading, tons/sq.ft.</div> <div>1.0 2.0 3.0 4.0</div>			
	CLASSIFICATION					<div>× standard penetration "N", blows/ft.</div> <div>△ moisture content, %</div> <div>10 20 30 40</div>			
	Elevation Existing Surface	×	△	⌘	○				
	Brown sand & gravel,damp - Fill - 11.0"								
1									
	Brown silt,some clay,trace sand & gravel, damp,loose to medium dense								
2									
		8	13.8			×	△		
3									
4									
5	End of Boring	21	15.5				△	×	
6									
7									
8									
9									
10									

Water encountered at dry feet during drilling operations (W.D.).  
 Water recorded at dry feet on completion of drilling operations (A.D.).  
 Water recorded at feet hours after completion of drilling operations (A.D.).

Logged By: DA

Page: 1 of 1

Client: Lake County Division of Transportation

File No. 22306

Date Drilled: 9/10/15

Reference: 21st Street  
Zion, IL

Comments: Station 26+00, 16' Rt. of CL

depth, ft.	Equipment: <input checked="" type="checkbox"/> CME 45B <input type="checkbox"/> CME 55 <input type="checkbox"/> Hand Auger <input type="checkbox"/> Other	standard penetration X	moisture content Δ	dry unit weight lbs./cu.ft. γ	unconfined compressive strength O	<div> ○ unconfined compressive strength, tons/sq.ft.  ● penetrometer reading, tons/sq.ft.  1.0 2.0 3.0 4.0 </div>				<div> X standard penetration "N", blows/ft.  Δ moisture content, %  10 20 30 40 </div>			
	CLASSIFICATION												
Elevation	Existing Surface												
1	Brown sand & gravel,damp - Fill - 11.0"												
2	Brown-gray clay,some silt,trace sand & gravel,damp,hard												
3		10	17.0	114.1	4.4	X	Δ					4.4	O
4	Brown-gray clay,some silt,trace sand & gravel,damp,very tough												
5	End of Boring	18	14.2	122.5	3.8		Δ	X					O
6													
7													
8													
9													
10													

Water encountered at dry feet during drilling operations (W.D.).  
Water recorded at dry feet on completion of drilling operations (A.D.).  
Water recorded at feet hours after completion of drilling operations (A.D.).



SOIL AND MATERIAL CONSULTANTS, INC.

# General Notes

## SAMPLE CLASSIFICATION

Soil sample classification is based on the Unified Soil Classification System, the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM D-2488, the Standard Test Method for Classification of Soils for Engineering Purposes, ASTM D-2487 (when applicable), and the modifiers noted below.

### CONSISTENCY OF COHESIVE SOILS

<u>Term</u>	<u>Qu -tons/sq. ft.</u>	<u>N (unreliable)</u>
Very Soft	0.00 - 0.25	0 - 2
Soft	0.26 - 0.49	3 - 4
Stiff	0.50 - 0.99	5 - 8
Tough	1.00 - 1.99	9 - 15
Very Tough	2.00 - 3.99	16 - 30
Hard	4.00 - 7.99	30 +
Very Hard	8.00 +	

### RELATIVE DENSITY OF GRANULAR SOILS

<u>Term</u>	<u>N - blows/foot</u>
Very Loose	0 - 4
Loose	5 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	50 +

### IDENTIFICATION AND TERMINOLOGY

<u>Term</u>	<u>Size Range</u>
Boulder	over 8 in.
Cobble	3 in. to 8 in.
Gravel	1 in. to 3 in.
-coarse	3/8 in. to 1 in.
-medium	3/8 in. to 1 in.
-fine	#4 sieve to 3/8 in.
Sand	#10 sieve to #4 sieve
-coarse	#10 sieve to #4 sieve
-medium	#40 sieve to #10 sieve
-fine	#200 sieve to #40 sieve
Silt	0.002 mm to #200 sieve
Clay	smaller than 0.002 mm

### Modifying Term      Percent by Weight

Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

### Moisture Condition

Dry  
Damp  
Very Damp  
Saturated

### DRILLING, SAMPLING & SOIL PROPERTY SYMBOLS

CF	- Continuous Flight Auger
HS	- Hollow Stem Auger
HA	- Hand Auger
RD	- Rotary Drilling
AX	- Rock Core, 1-3/16 in. diameter
BX	- Rock Core, 1-5/8 in. diameter
NX	- Rock Core, 2-1/8 in. diameter
S	- Sample Number
T	- Type of Sample
J	- Jar
AS	- Auger Sample
SS	- Split-spoon (2 in. O.D. with 1-3/8 in. I.D.)
ST	- Shelby Tube (2 in. O.D. with 1-7/8 in. I.D.)
R	- Recovery Length, in.
B	- Blows/ 6 in. interval, Standard Penetration Test (SPT)
N	- Blows/ foot to drive 2 in. O.D. split-spoon sampler with 140 lb. hammer falling 30 in., (STP)
Pen.	- Pocket Penetrometer reading, tons/ sq. ft.
W	- Water Content, % of dry weight
Uw	- Dry Unit Weight of soil, lbs./ cu. ft.
Qu	- Unconfined Compressive Strength, tons/ sq. ft.
Str	- % Strain at Qu.
WL	- Water Level
WD	- While Drilling
AD	- After Drilling
DCI	- Dry Cave-in
WCI	- Wet Cave-in
LL	- Liquid Limit, %
PL	- Plastic limit, %
PI	- Plasticity Index (LL-PL)
LI	- Liquidity Index [(W-PL)/PI]